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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: SAVIDGE et al.
S/N: 10/664,335
Filed: September 17, 2003
Entitled: Non-return Valves for Vacuum Pumps

Group: to be assigned

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

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Attached please find the certified copies of the foreign applications from which priority is claimed for the subject patent application.

Country:	United Kingdom
Application Number:	0221918.6
Filed:	September 20, 2002

Country:	United Kingdom
Application Number:	0321051.5
Filed:	September 8, 2003

Respectfully submitted,

Date: Oct 8, 2003

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CERTIFICATE OF MAILING (37 CFR 1.8)

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Signature of Person Mailing Paper: Betty Lee Date: October 8, 2003
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The Patent Office
Concept House
Cardiff Road
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The Patent Office

Cardiff Road
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1. Your reference — MB/J00044664GB

2. Patent application number *(The Patent Office will fill in this part)* — 0221918.6

225EP02 E749964-2 002829
P01/7700 0.00-0221918.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

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Patents ADP number *(if you know it)* — 7975949001

If the applicant is a corporate body, give the country/state of its incorporation — UK

4. Title of the invention — Non-Return Valves for Vacuum Pumps

5. Name of your agent *(if you have one)* — RGC Jenkins & Co

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

26 Caxton Street
London SW1H ORJ
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Patents ADP number *(if you know it)* — 03966736001

BOC GROUP PLC
CHERTSEY ROAD
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SURREY, GU20 6HJ

FSI MJD 28.9.01

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications *(and if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month/ year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month/ year)*

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a) any applicant named in part 3 is not an inventor, or
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Continuation sheets of this form	
Description	7
Claim(s)	3
Abstract	1
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Priority documents	
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature RGC Jenkins & Co Date 20 September 2002

RGC JENKINS & CO

12. Name and daytime telephone number of person to contact in the United Kingdom

Mark Baldwin 020-7931-7141

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DUPLICATE

Non-Return Valves for Vacuum Pumps

The invention relates to non-return valves for vacuum pumps.

Non-return valves, sometimes referred to as check valves, are commonly used with vacuum pumps. A non-return valve is most often used on the exhaust side of a vacuum pump and is arranged to permit gas/vapour to exhaust from the pump and prevent backflow of the gas/vapour.

A known non-return valve makes use of a ball working against gravity. In use, the ball seats against a valve seat until such time as the exhaust pressure is sufficient to lift the ball from the seat against gravity. As long as the exhaust pressure is sufficient to hold the ball off the seat, the valve is open to permit the passage of gas/vapour from the pump. If the exhaust pressure falls to the extent it cannot support the ball against gravity, the ball falls back against the valve seat to prevent backflow of gas/vapour into the pump.

The valve seat of the known non-return valve is made of metal and in order to provide good gas sealing properties, the ball is either made of elastomeric material, or comprises a metal former coated with an elastomeric material. The elastomer is required to be sufficiently compliant to provide a good gas seal.

The known non-return valve works well, but there are problems encountered when corrosive gases/vapours are pumped. An example of such a gas vapour is one containing flourine. The elastomeric compounds normally used in vacuum pump sealing, such as fluorelastomers, for example, Viton (Trade Name), are prone to attack by the flourine content of vacuum pump exhaust. The metal components are also attacked by these corrosive

gases/vapours, but are typically much more resistant than the elastomeric compounds normally used.

In order to cope with pumping corrosive gases/vapours, elastomers having an increased resistance to attack can be used. Examples of elastomers with increased resistance to flourine attack are perfluoroelastomers, such as Chemraz (Registered Trade Mark) and Kalrez (Registered Trade Mark). However, these materials are significantly more expensive than the more commonly used materials such as Viton and while a satisfactory ball made of solid Chemraz or Kelraz can be produced, this adds enormously to the cost of producing a non-return valve.

In cases where the ball is to be made by coating a metal former, the cost problem can be reduced, but the choice of elastomers that can be used is limited by the requirement that they must be capable of over-moulding onto a metal former.

An object of the invention is to at least partially overcome one or more of the above-described problems and/or provide a useful choice.

The invention provides a vacuum pump non-return valve comprising a valve body that defines a through-passage having an inlet end and an outlet end, a valve seat disposed intermediate said inlet and outlet ends defined by an insert made of an elastomeric material, and a ball arranged to seat against said valve seat to prevent passage of gaseous fluids from said outlet end to said inlet end and being displaceable, in use, from said valve seat by pressurised gaseous fluid in said inlet end to permit passage of said gaseous fluid from said inlet end to said outlet end.

The invention also includes a vacuum pump non-return valve, said valve comprising a cast body part having an inlet, an outlet and a location for

receiving an insert, an insert made of an elastomeric material located at said location and a ball, said insert defining a valve seat and said ball being arranged to seat on said valve seat to prevent passage of gaseous fluids from said outlet to said inlet and being displaceable, in use, from said valve seat by gas pressure acting on an upstream facing side thereof to permit said gaseous fluid to pass from said inlet to said outlet.

The invention also includes a vacuum pump having a part defining a flowpath for gaseous fluids and a non-return valve in said flowpath, said non-return valve comprising a valve seat insert and a ball, said valve seat insert being made of an elastomeric material and being positioned relative to said flowpath such that when, in use, said ball is seated on the valve seat, the flow of gaseous fluids in said flowpath is prevented and when there is a predetermined gas pressure in said flowpath upstream of the non-return valve, the ball is moved from said valve seat by gas pressure so that the gaseous fluid can flow to positions of the flow path downstream of the non-return valve.

The invention also includes a method of preventing backflow of exhaust gas to a vacuum pump, said method comprising providing a valve seat consisting of an insert made of an elastomeric material in a flowpath for said exhaust gas and providing a ball on said valve seat to prevent passage of said exhaust gas, the ball being arranged such that it seats against said valve seat under the influence of gravity and is displaceable against gravity by gas pressure upstream of said ball valve.

Where the valve seat is to be exposed to gases/vapours containing aggressive media such as flourine the elastomeric material is advantageously selected from a compound having improved resistance to chemical attack. Examples of suitable compounds are Chemraz, Kalrez or Simriz. However, the invention is not to be taken as limited to these compounds and valve seats

made from elastomeric materials having the desired properties for a particular pumping environment can readily be substituted as required.

In order that the invention may be well understood, an embodiment thereof, which is given by way of example only, will now be described with reference to the drawings in which:

Figure 1 is a sectioned side elevation of a non-return valve mounted to a vacuum pump; and

Figure 2 is a view corresponding to Figure 1 showing a modified version of the non-return valve.

Referring to Figure 1, a non-return valve 10 comprises a valve body 12. The valve body is typically a hollow metal casting. The valve body 12 defines a through-passage having an inlet side 14i and an outlet side 14e. Between the inlet side 14i and the outlet side 14e, there is a valve seat 16 defined by an O-ring on which is seated a ball 18. Above the valve seat 16 on the outlet side 14e side of the non-return valve, there is a chamber 20 into which the ball can rise. The chamber 20 is open at its outer end to permit the insertion and removal of a core during the casting process. The open end of the chamber 20 is closed by a plate 22 that is secured to the valve body by means of cap-head socket screws or the like. The plate 22 seals against a seal 24 that is provided between the valve body 12 and the plate to provide a gas-tight seal.

A flange 26 is provided at the outer end of the inlet side 14i of the through-passage, i.e. the end that is remote from the valve seat 16. The flange is provided with suitable through-holes (not shown) through which screws can pass to allow the non-return valve to be secure to a vacuum pump 28. A recess 30 is provided in the flange 26 to receive a seal, such as an O-ring, to provide a gas-tight seal between a vacuum pump 28 and the flange 26. Similarly, the outer end of the outlet side 14e of the through-passage is

provided with a flange 32 and a recess 34 to permit a gas-tight connection to be made to downstream apparatus, or a conduit leading to such apparatus. An example of apparatus that might be connected downstream of the non-return valve is an abatement system.

At the lower, or inner end, of the chamber 20, the valve body 12 defines a shoulder in which the O-ring 16 seats. The O-ring comprises any suitable elastomeric compound. If the non-return valve is to be used to pump aggressive flourine containing gases/vapours, the O-ring should be made of a suitably resistant compound, such as Chemraz or Kalrez.

The ball is made from a metal, such as a stainless steel or other suitable metal, which will usually be selected for its resistance to corrosion.

In use, when the pump 28 is pumping, exhaust gases pass from the pump into the inlet side 14i of the through-passage and provided there is sufficient pressure, the ball 18 is lifted from the O-ring that defines the valve seat 16, permitting the passage of the exhaust gases into the lower end of the chamber 20 and from there into the outlet side 14e of the through passage, from where the gases pass from the non-return valve. If the pressure from the pump 28 falls to the extent it is insufficient to support the ball 18, the ball falls back against the valve seat 16 under the influence of gravity. When the ball 18 seats against the valve seat 16 defined by the O-ring, a substantially gas-tight seal is provided between the sides 14i, 14e of the through-passage, thereby preventing the backflow of gases into the pump 28.

It will be appreciated that the valve body 12 may take many forms. For example, it is not essential to provide the outlet side 14e of the through-passage as shown. Instead, the chamber 20 could define the outlet end of the through-passage, by removing the plate 22. In such an arrangement, there

would typically be a flange similar to the flanges 26, 32, provided in the region occupied by the plate 22 in Figure 1.

It will be appreciated that where expensive compounds such as Chemraz or Kalrez are to be used, the non-return valve 10 has advantages over the known valve provided with a solid elastomeric ball. As indicated previously, compounds such as Chemraz and Kalrez are expensive and it is estimated that a valve seat 16 in the form of an O-ring made from such materials will cost in the region of 7% of the cost of a solid ball made from the same material.

A further advantage of the non-return valve shown in Figure 1, as compared with a valve using a ball comprising a metal former coated with a compound, is that it is not limited to using compounds that are capable of being moulded onto a metal former. Thus, in terms of selecting a suitable compound for a particular operating environment, the freedom of the designer is enhanced

Furthermore, because the designer is not so much constrained by cost of the compound or the need for the compound to be capable of moulding onto a former, when new elastomers having improved qualities become available, it is relatively straightforward to bring them into use in the non-return valve.

It is to be understood that while the valve seat 16 is conveniently defined by an O-ring as shown in Figure 1, the valve seat can be defined by insert seals having a different configuration, should this be required and/or desirable.

It will be appreciated that the ball while made of metals may be coated with a non-stick material to prevent it from sticking to the valve seat 16. An example of a suitable non-stick material is polytetrafluoroethylene (PTFE).

It will be understood that whilst the embodiment is described as having flanges, which allow the non-return valve to be secured to a vacuum pump and piping leading from the vacuum pump by means of screws or the like, this is not to be taken as limiting. For example, the valve body could be provided with threading so that the valve could be screwed directly to cooperating threading on a vacuum pump.

It will also be appreciated that the non-return valve may be provided by fitting the insert valve seat 16 and ball 18 into a passage defined in a pump and in this case, the pump, or a part of the pump, will define the valve body 12.

A possible modification to the non-return valve 10 is shown in Figure 2. The modification comprises the provision of a compression spring 40 between the ball 18 and the plate 22. The spring 40 is arranged to bias the ball to a position in which it engages the valve seat 16 defined by the O-ring. It will be appreciated that spring can be selected such that the ball will not lift from the valve seat until the pressure of the gas/vapour in the inlet side 14i of the through-passage at least reaches a predetermined threshold and the presence of the spring will ensure that if the pressure in the inlet side falls below that threshold pressure, the ball will promptly be pressed back against the valve seat to prevent the backflow of gas/vapour from the outlet side 14e to the inlet side 14i.

CLAIMS

1. A vacuum pump non-return valve comprising a valve body that defines a through-passage having an inlet end and an outlet end, a valve seat disposed intermediate said inlet and outlet ends defined by an insert made of an elastomeric material, and a ball arranged to seat against said valve seat to prevent passage of gaseous fluids from said outlet end to said inlet end and being displaceable, in use, from said valve seat by pressurised gaseous fluid in said inlet end to permit passage of said gaseous fluid from said inlet end to said outlet end.

2. A valve as claimed in claim 1, wherein said ball is made of metal.

3. A valve as claimed in claim 2, wherein said ball is coated with a non-stick material to prevent sticking to said valve seat.

4. A valve as claimed in claims 1, 2 or 3, wherein said insert is an O-ring.

5. A valve as claimed in any one of the preceding claims, wherein said insert is made of fluorelastomer.

6. A valve as claimed in any one of claims 1 to 4, wherein said insert is made of perfluorelastomer.

7. A valve as claimed in any one of the preceding claims, wherein said valve body is a casting.

8. A vacuum pump non-return valve, said valve comprising a cast body part having an inlet, an outlet and a location for receiving an

insert, an insert made of an elastomeric material located at said location and a ball, said insert defining a valve seat and said ball being arranged to seat on said valve seat to prevent passage of gaseous fluids from said outlet to said inlet and being displaceable, in use, from said valve seat by gas pressure acting on an upstream facing side thereof to permit said gaseous fluid to pass from said inlet to said outlet.

9. A vacuum pump non-return valve substantially as hereinbefore described with reference to the drawings.

10. A vacuum pump provided with a non-return valve as claimed in any one of the preceding claims.

11. A vacuum pump having a part defining a flowpath for gaseous fluids and a non-return valve in said flowpath, said non-return valve comprising a valve seat insert and a ball, said valve seat insert being made of an elastomeric material and being positioned relative to said flowpath such that when, in use, said ball is seated on the valve seat, the flow of gaseous fluids in said flowpath is prevented and when there is a predetermined gas pressure in said flowpath upstream of the non-return valve, the ball is moved from said valve seat by gas pressure so that the gaseous fluid can flow to positions of the flow path downstream of the non-return valve.

12. A method of preventing backflow of exhaust gas to a vacuum pump, said method comprising providing a valve seat consisting of an insert made of an elastomeric material in a flowpath for said exhaust

gas and providing a ball on said valve seat to prevent passage of said exhaust gas, the ball being arranged such that it seats against said valve seat under the influence of gravity and is displaceable against gravity by gas pressure upstream of said ball valve.

13. A method of preventing backflow of exhaust gas in a vacuum pump substantially as hereinbefore described with reference to the drawings.

ABSTRACT

Non-Return Valves for Vacuum Pumps

A vacuum pump non-return valve comprises a valve body (12) that defines a through-passage having an inlet side (14i) and an outlet side (14e). A valve seat (16) is disposed intermediate said inlet and outlet sides of the through-passage. The valve seat (16) is defined by an insert made of an elastomeric material. The non-return valve has a ball (18) arranged to seat against the valve seat to prevent the passage of gaseous fluids from the outlet side (14e) to the inlet side (14i). The ball is displaceable, in use, from valve seat by pressurised gaseous fluid in the inlet side of the through-passage to permit passage of gaseous fluid from the inlet side to the outlet side of the through-passage.

(Figure 1)

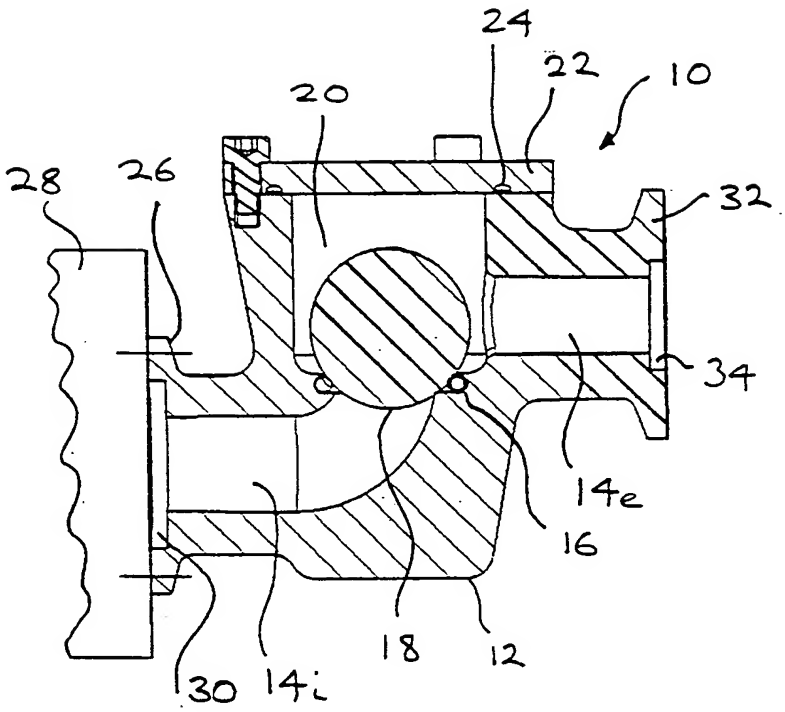

Figure 1

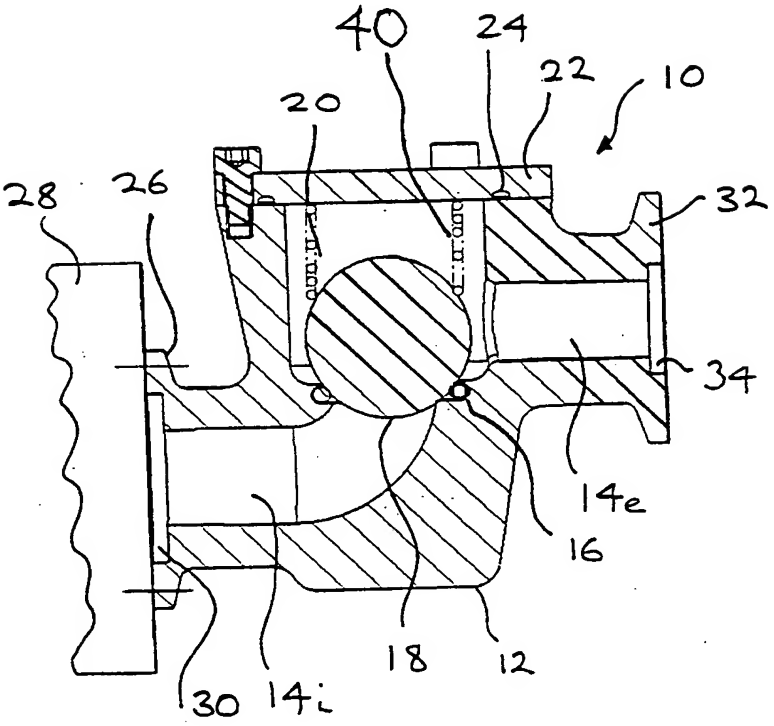

Figure 2